

WHAT IS CLAIMED IS:

- 1 1. A method to create a digital model of a patient's teeth, comprising:
2 creating an impression of the patient's teeth;
3 scanning the impression using an X-ray source; and
4 generating the digital model with scanned data.
- 1 2. The method of claim 1, further comprising using passing the radiation
2 source through a scintillator.
- 1 3. The method of claim 2, further comprising digitizing the output of the
2 scintillator.
- 1 4. The method of claim 1, wherein the impression of the teeth is taken in
2 a plastic tray.
- 1 5. The method of claim 1, further comprising taking a bite impression of
2 the patient.
- 1 6. The method of claim 5, wherein the bite impression is taken using a
2 PVS material.
- 1 7. The method of claim 5, wherein the bite impression is taken using a
2 wax bite.
- 1 8. The method of claim 1, wherein an upper teeth impression, a lower
2 teeth impression and a bite impression is scanned together.
- 1 9. The method of claim 8, further comprising digitally reversing data
2 from the upper and lower impression scan data to make positive data.
- 1 10. The method of claim 9, wherein the digital reversing identifies inner
2 surfaces of an impression material and extracting the inner surfaces using a largest connected
3 component algorithm.
- 1 11. The method of claim 1, further comprising aligning data into a bite
2 position using the bite material scanned.

1 12. The method of claim 1, further comprising digitally detailing the teeth
2 data.

1 13. The method of claim 1, further comprising setting a final bite.

1 14. The method of claim 1, further comprising articulating the digital
2 model.

1 15. The method of claim 1, further comprising treating a patient using the
2 digital model.

1 16. The method of claim 1, further comprising:
2 generating a computer representation of a masticatory system of the patient;
3 and
4 determining an occlusion from the computer representation of the masticatory
5 system.

1 17. The method of claim 16, wherein the occlusion is a static occlusion,
2 further comprising:
3 modeling an ideal set of teeth;
4 automatically applying the ideal set of teeth to the computer representation of
5 a masticatory system of the patient; and
6 optimizing the position of the patient's teeth to fit the ideal set of teeth.

1 18. The method of claim 17, wherein the modeling step further comprises
2 selecting one or more arch forms specifying the ideal set of teeth.

1 19. The method of claim 17, wherein the masticatory system includes jaws
2 and wherein the applying step includes:
3 registering a model of the upper and lower teeth with a model of the
4 masticatory system;
5 simulating the motion of the jaws to generate contact data between the upper
6 and lower teeth; and
7 placing a tooth in a final position based on the contact data.

- 1 20. The method of claim 19, wherein the model is registered using X-ray
2 data.
- 1 21. The method of claim 19, wherein the model is registered using
2 computed tomography data.
- 1 22. The method of claim 19, wherein the model is registered using data
2 associated with a mechanical model.
- 1 23. The method of claim 19, wherein the simulating step further comprises
2 applying kinematics to the model of the teeth.
- 1 24. The method of claim 19, wherein the simulating step further
2 comprises applying a constrained motion to the model of the tooth.
- 1 25. The method of claim 19, wherein the placing step is based on a
2 measure of undesirability to the contacts.
- 1 26. The method of claim 25, further comprising optimizing the position of
2 the tooth according to the measure of undesirability.
- 1 27. The method of claim 26, further comprising minimizing the measure of
2 undesirability.
- 1 28. The method of claim 27, wherein the measure of undesirability is a
2 function of one or more of Peer Assessment Rating (PAR) metrics, distance-based metrics
3 and shape-based metrics.
- 1 29. The method of claim 17, wherein the simulating step includes
2 providing a library of motions.
- 1 30. The method of claim 29, wherein the library of motions includes a
2 protrusive motion.
- 1 31. The method of claim 29, wherein the library of motions includes a
2 lateral motion.

1 32. The method of claim 29, wherein the library of motions includes tooth-
2 guided motions.

1 33. The method of claim 17, wherein the simulating step includes applying
2 physical forces to one jaw.

1 34. The method of claim 17, wherein the placing step further includes
2 updating the computer representation of the masticatory system with new patient data.

1 35. The method of claim 34, wherein the patient has a first teeth model,
2 further comprising:
3 scanning the teeth of the patient to generate a second teeth model;
4 matching the second teeth model with the first teeth model;
5 applying a final position transform to the second teeth model; and
6 adjusting the position of teeth in the second model based on new information.

1 36. An apparatus to create a digital model of a patient's teeth, comprising:
2 a radiation source;
3 a scintillator to receive the radiation from the radiation source;
4 a radiation detector coupled to the scintillator;
5 a rotatable table positioned between the radiation source and the scintillator,
6 the table being adapted to support an impression of the patient's teeth; and
7 a computer coupled to the detector to generate the digital model with scanned
8 data.

1 37. The apparatus of claim 36, wherein the radiation source is an X-ray
2 source.

1 38. The apparatus of claim 36, wherein the radiation source is a computed
2 tomography source.

1 39. The apparatus of claim 36, wherein the rotatable table is adapted to
2 support an upper teeth impression, a lower teeth impression and a bite impression.

1 40. The apparatus of claim 36, further comprising a fabrication machine
2 coupled to the computer to generate a plurality of appliances, wherein the appliances

- 3 comprise polymeric shells having cavities and wherein the cavities of successive shells have
- 4 different geometries shaped to receive and resiliently reposition the teeth from one
- 5 arrangement to a successive arrangement.